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$$\frac{15 \times 30}{12 \times 1.2} = 31.25.$$

Find the time required with an electric current of 10 K and a potential of 100 to heat unit mass of helium (atomic weight, 4) through a temperature interval of 10 M, at constant pressure. (The specific heat of a monatomic gas at constant *volume* is 3/2.) Answer:

$$\frac{\frac{1}{4} \times 10^7 \times (\frac{3}{2} + 1)}{10^4 \times 100} = 62.5 \text{ sec.}$$

Find the mass of copper (valence 2, at.wt. 63.57) that would be deposited by a current of 10 K in 1,000 sec. Answer:

$$\frac{63.57 \times 10^4 \times 1{,}000}{2 \times 10^9} = 0.318.$$

Find the capacity of a condenser with 100 sheets of dielectric (of dielectric constant 2) each of unit area and thickness 0.01. Answer:

$$\frac{100 \times 1 \times 2}{10^9 \times 0.01} = 2 \times 10^{-5} = 20\mu.$$

Find the inductance of a coil of 100 turns wound on a closed core of iron of permeability 1,000, of cross section 0.2 × 0.2 and length of magnetic circuit 4. Answer:

$$\frac{100^2 \times 1{,}000 \times .2 \times .2}{10^9 \times 4} = 10^{-4}.$$

Find the magnetic energy of the core when a current of 1 K is passing through the coil. Answer:

$$\frac{1}{2} \times (10^3)^2 \times 10^{-4} = 50.$$

In conclusion, it should be noted that the foregoing is primarily a description of a method of deriving a system of units, and that a system of substantially equal convenience could be devised with an other than decimal arithmetic, a different unit of time or another basis of atomic weights.

SUMMARY

1. On the common foundation of the English and metric systems of units there can be constructed a system superior to either.

2. Its bases are (1) the mean solar second, (2) a length of 29.986 cm. and (3) a mass of 25.636 g.

3. Tables of the relation of the various units in this system to the corresponding metric units are given.

4. A single set of units serves for both engineering and scientific purposes.

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PALEONTOLOGY AND PRAGMATISM

Two recent publications of the United States National Museum admirably illustrate a phase of the scientific activities of the government to which I have long thought of calling attention, since they are accomplished without noise or press notices and are of immense value to the people as a whole in addition to their intrinsic scientific worth.

The publications to which I refer are North American Early Tertiary Bryozoa, by Canu and Bassler, constituting Bulletin 106, and Contributions to the Geology and Paleontology of the Canal Zone, by T. Wayland Vaughan and associates, constituting Bulletin 103. More particularly I wish to refer to the work of Canu and Bassler on the Bryozoa, Joseph A. Cushman on the Foraminifera, Marshall A. Howe on the calcareous algæ, and T. Wayland Vaughan on the corals.

These are all groups of organisms whose habits are exceedingly interesting and whose forms are often highly artistic, but none of which furnish food for commercial fishes or humanity, or are objects of trade,[1] or yield any gums, wax, gems, or minerals that might make them seemingly worth while to the man in the street.

The Bryozoa are inconspicuous colonial animals, some of them with a beauty all their own, but seldom appreciated since they require magnification in order to be seen to advantage. Some are usually included in amateur collections of so-called sea weeds, but to the average person a bryozoan is as unknown as a native of Mars. The recently installed sea

[1] The red coral of commerce and its imitations are exceptions, but these are European and not American products and do not affect the force of the statement.

bottom exhibit in colored glass at the American Museum of Natural History will undoubtedly call the attention of a considerable circle to the wonderful habits and esthetic forms of these tiny animals. That the monograph by Canu and Bassler is a splendid contribution to paleozoology goes without saying —the names of the authors are a guarantee of that—what I wish to emphasize is the utilitarian value of such studies.

The Bryozoa belong to a geologically very old phylum, the vast majority secrete a calcareous skeleton, and since they are so plentiful and so tiny they are preserved as fossils in great abundance at very many geological horizons. They are thus admirably adapted to become medals of creation, and highly satisfactory time markers for geologists. They well illustrate the old aphorism of the importance of the insignificant, since while infinitely varied in detail, their specific limits are usually sharp and their range in time is not too great to enable them to be used with great precision in the determination of the age of geological formations and their correlation over wide areas. Their value has long been recognized in the older geological formations of the Paleozoic and Mesozoic, but in this country at least, their usefulness in delimiting the later formations, has hitherto remained unevaluated.

Geologic correlation may seem remote from the affairs of the workaday world and yet upon its successful consummation rests not only the understanding of the local and general relations underground that are the basis of all exploitation of artesian waters, oil, and other mineral resources of the earth, but it is of prime importance in determining the places or origin and the paths of migration of the life of bygone days. The early Tertiary bryozoa of the Atlantic Coastal Plain not only serve to substantiate the evidence derived from other classes of fossils, but may be expected to eventually help determine whether the past floodings of this region were simultaneous with similar events in the Old World and hence caused by changes in sea level or whether these were due to regional changes in the attitude and elevation or depression of the land.

National Museum Bulletin 103 contains elevent different papers upon the geology and paleontology of the Canal Zone and much additional information with regard to the Antilles, especially with respect to the corals. In fact, if the Mollusca could have been included, it would serve as a complete manual of the geology and paleontology of that region.

A knowledge of calcareous algæ, either recent or fossil, is confined to a few specialists. Their fossil remains have never been much used in stratigraphic geology, because, like the bryozoa, diatoms and foraminifera, sufficient intelligence had not been focused upon them to determine their value as indicators of horizons, past events, or past physical conditions. It is only recently that their importance in the formation of magnesium carbonate and the great part they take in the formation of the so-called coral reefs of both the past and the present, has been understood.

The Foraminifera constitute a group of organisms that are exceedingly abundant in existing seas, and useful in a variety of ways in studies of plankton and experimental evolution. They belong to the great and primitive group of the Protozoa, or unicellular animals, and since, unlike so many of their congeners, they early acquired a siliceous or calcereous skeleton they have been preserved in ever increasing abundance in certain marine formations from the Silurian down to the present.

Although they have been utilized to some extent abroad, particularly in the recognition of zones in the nummulitic limestones of the Mediterranean regions, they have attracted but few students in this country, and have been rather generally regarded as lacking in chronologic value. This reputation was largely the result of the specific limits as conceived by English students such as Parker, Jones and Brady, who published large standard works in which single species showed most astonishing ranges of millions of years. Naturally forms that live on unchanged for eons

may safely be ignored in trying to determine the age and succession of the rocks.

It may be doubted, however, if any class of organisms do not have an interesting and important story to tell provided we learn their language. This has proven to be the case with our American foraminifera at the hands of Cushman. Since forams are generally small and abundant when present at all they stand a much better chance of preservation in both compact limestones and coarse sandy marls than do the tests of higher and larger marine organisms. They have been particularly useful in tracing the Tertiary geological zones around the equatorial belt of the world. In Panama, around the borders and on the islands of the Spanish Main, as well as in our own southern coastal plain, the Foraminifera have proven to be often the only, and always among the most satisfactory types of fossils. Widely distributed in the seaways, rapidly mutating into recognizable differentials, they have been one of the keys to our understanding of the history of equatorial America.

They, like the Bryozoa, are generally small enough to be present in well samples where larger forms are not encountered or are largely smashed beyond recognition by the drills. They have lately been shown to be of profound significance in the location of the oil sands by means of a study of well cuttings in the Texas oil fields. They are almost the only fossils in the thick series of calcareous clays that overlie the oil sands in the Tampico district, and in this last region alone will eventually contribute more in dollars and cents to the wealth of the world than all of the issues of the Congressional Record that have ever been printed.

Probably the laymen requires no introduction to corals. All boys can probably be divided into two classes, at least such was once the case—those who avowed that they were going to be locomotive engineers when they grew up, and those who longed to explore a coral reef or live on a South Pacific coral atoll. Any one who has never experienced the thrill that comes from contemplating the profusion of surging life in and around a coral reef, or does not know the fascinating beauty of even the dead skeletons of coral life would do well to read the popular illustrated account by Vaughan in the last annual report of the Smithsonian Institution.

Corals are all small marine animals, but many of them dwell in colonies, notably the so-called stone corals, and secrete the calcareous skeletons familiarly known as corals. Like the Bryozoa, corals are sedentary except for the short period when they have a free-swimming larval fling as it were. Their ancestors go back as far as the fossil records go, and they have never suffered the obliquity as horizon markers that has at times attached to the Bryozoa and Foraminifera.

Reef corals require definite temperatures and environmental conditions in order to flourish. hence they are useful in retrospective prophecy. Geologically they are especially important during later geological times in Mediterranean regions—in the south of Europe, the Antilles, and the balance of equatorial America. Their contribution to our understanding of the relations and geological history of the Antilles is probably not equalled and certainly not exceeded by any other group of organisms.

In conclusion to cite but a single pragmatic instance of the ultimate commercial value of these monographic paleontologic studies that are published by the National Museum—the exploration for oil in central and northern South America, and the successful interpretation of structure that is the key to commercial success or failure in the far off *tierra caliente* of Colombia or Venezuela, rests very largely on the application of the results of the unostentatious and unadvertised paleontologic studies.

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SCIENTIFIC EVENTS

A NEW OBSERVATORY IN CLEVELAND

CASE School of Applied Science, Cleveland, Ohio, dedicated a new observatory on Columbus Day, October 12, 1920. It is to be known